

REMARKS

Claims 31-40 are currently pending in this application.

Applicants thank the Examiner for participating in a telephone interview on May 3, 2007 so that Applicants had the opportunity to explain their invention. The Examiner indicated that she would revisit the claims in light of our discussion.

Rejection of Claim 31-40 under 35 U.S.C. § 103 (a)

The Examiner has rejected claims 31-40 under 35 U.S.C. § 103 (a) as being unpatentable over "The Expert Surgical Assistant: An Intelligent Virtual Environment with Multimodal Input" (Billinghurst) in view of U.S. Patent No. 6,470,207, (Simon). The Examiner correctly notes that Billinghurst does not teach or disclose inserting an instrument to a depth determined in the augmented view by alignment of a predetermined real feature of the real instrument with the virtual depth marker. The Examiner contends that Simon discloses inserting the instrument to a depth determined in the augmented view by alignment of a predetermined feature of the instrument with the virtual depth marker. Applicants respectfully traverse the rejection.

Applicants' invention is directed to a method and apparatus for augmented reality guided positioning of an instrument tip within a target located in an object. An augmented reality view is presented by overlaying a virtual graphics guide onto a real view of the object and an instrument. The graphics guide comprises a virtual depth marker located outside of the object. The instrument is aligned to the graphics guide. The instrument is inserted to a depth determined in the augmented view by alignment of a predetermined feature of the instrument with the virtual depth marker. The feature is located along the length of the instrument at a certain distance from the instrument tip and remains external to the object during insertion.

Billinghurst discloses a system for addressing instrument location and navigation. A coronal and axial CT scan is displayed alongside a simulated endoscope view. The instrument tip is marked on these images with a cross which moves according to the user's instrument motion. The CT scan also changes in response to instrument depth, so the current images are those corresponding to the instrument tip location within the nasal cavity. Applicants submit that this is very different from Applicant's invention. As stated previously, Applicants do not track the location of the instrument through images. Applicants monitor the location and movement of the instrument using an external perspective, namely the perspective of the user. The depth marker is explicitly shown to the user, and used to guide the instrument to the target. The location of the instrument is only seen by the user, it is not being calculated by the system. The present invention does not track the coordinates of the instrument; the alignment of the virtual depth marker with the real feature on the real instrument indicates correct depth placement of the instrument to the user. Applicants respectfully submit that Billinghurst does not teach or disclose Applicants' invention as claimed.

Simon discloses a surgical navigational guidance system which uses one or more fluoroscopic x-ray images. Representations of surgical instruments are overlaid on pre-acquired fluoroscopic images of a patient based on the position of the instrument as determined by a tracking sensor. This allows the physician to see the location of the instrument relative to the patient's anatomy as depicted in the fluoroscopic X-ray images. Simon uses a virtual cone as a mathematical reference to the volume that is being imaged by the X-ray imaging system. The location and opening angle of the virtual cone determine the field-of-view of the X-ray system. Simon determines the coordinates of the virtual cone with respect to the coordinate system of the tracking system so that he can overlay a virtual model of the tracked instrument spatially correct onto the X-ray image of the

patient's anatomy. Tracking of the instrument is a prerequisite for Simon's method.

Applicants respectfully submit that the Simon system is very different than that of the present invention. The present invention is an augmented reality system that allows a user to determine the depth of an instrument being inserted into an object from an external perspective. The depth marker is explicitly shown to the user and used to guide the instrument to the target. The present invention also does not track the coordinates of the instrument; the alignment of the virtual depth marker with the real feature on the real instrument indicates correct depth placement of the instrument.

Simon uses the virtual cone to illustrate the volume that is being imaged by the X ray system and which is then determined in the coordinates of the tracking system. Unlike the present invention, the virtual cone is not shown to the user and therefore cannot provide any guidance to the user; in particular, it does not serve as a depth marker. As indicated in column 12, lines 10-23, the virtual cone is known in the coordinate system of the tracking system. The cone is used to understand the spatial relationship of the X-ray system's field-of-view with the tracked position of the instrument, which allows one to indicate the instrument position (known to the system by instrument tracking) in the fluoroscopic image with a virtual instrument. The virtual instrument can be used by the physician to guide the trajectory of the real instrument.

This is fundamentally different from the present invention. The present invention does not use a virtual instrument to guide the positioning of the real instrument in the target. The only tool used to position the real instrument in the present invention is the virtual graphics guide with the virtual depth marker. The alignment of the virtual depth marker and the feature on the instrument ensures that the instrument has been inserted at the appropriate depth to reach the target. Unlike Simon, the present invention does not allow the user to virtually

see the instrument within the patient. Nor does the present invention use a virtual instrument to guide the insertion of the real instrument.

The Examiner also refers to column 7, lines 49-51 where Simon discloses an instrument embedded with infrared emitters or reflectors. Applicants submit that this is different from the real feature cited in the claims because it does not remain external to the object and the infrared emitters are used with a tracking sensor (see col. 7, lines 45-61) to communicate to a computer the location of the instrument. The emitters would be located on the part of the instrument that is inserted into the body to assist in tracking the movement of the instrument within the body. Applicants' invention is applied by the user visually matching up the virtual depth marker with the real feature on the instrument. This match up occurs on a part of the instrument which is external to the object. Once the match up occurs, the user knows the depth to which the instrument has been inserted.

Applicants further submit that the combination of Billingham and Simon does not teach or disclose Applicants' invention as claimed. Neither Billingham nor Simon, whether taken alone or in combination, teach or disclose aligning a virtual depth marker located outside of a real object with a feature of a real instrument in order to position a real instrument tip within a real target in a real instrument as recited in amended claims 31 and 36. Claims 32-35 and 37-40, being dependent upon independent claims 31 and 36 respectively, are also not taught or disclosed by Billingham and Simon. Applicants respectfully request that the rejection under 35 U.S.C. § 103 (a) be withdrawn.

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Reply to Office Action of March 14, 2007

Conclusion

Applicants respectfully submit that claims 31-40 are in condition for allowance and request that a timely Notice of Allowance be issued in this case. The Examiner is invited to contact the undersigned should he have any questions in this matter.

Respectfully submitted,

A handwritten signature in cursive script, appearing to read "Michele L. Conover".

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